

**INVENTION
DISCLOSURE**

(WKRP Document No. 20010323.162258) *100114029*

PD Number: *██████████* Date Received by Legal: *██████████* Managing Attorney: *DGS*

Invention Disclosure status: Awaiting PD Number
Awaiting PD Number

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General Information

Section Complete

Title: Write a descriptive title of the invention.

One Pass Printing Error Hiding Methods

Abstract: Write a brief abstract of the invention.

This invention describes techniques used to hide nozzle outs in one-pass print modes.

Projects: Select projects associated with disclosed invention.

Nomodo

Products: Select product names or numbers associated with this invention.

Polaris

Description of Invention

Section Complete

Prior Solutions: List prior solutions and their disadvantages.

Multi-pass print modes were used to perform error-hiding of nozzle outs. However, this would decrease throughput. Also, people would not use whole sections of a pen in order to eliminate the use of the nozzle that does not fire. However, this would also significantly reduce throughput and put a greater burden on the nozzles that would remain in use and therefore, reduce pen life.

Problems Solved: Explain the problems solved by the invention.

Method 1: Boost the amount of ink used in adjacent nozzles to the nozzle that is out. Boost the ink usage in adjacent nozzles by the amount of ink that should be printed by the nozzle that is out. Vary the boost between the nozzle above and the nozzle below (i.e. if nozzle 267 is out, boost nozzles 266 and 268). Try to boost empty pixels in the adjacent nozzles before adding to pixels with ink. Do not boost above the maximum level (number of drops) allowed in the file.

Method 2: For the row with a nozzle out match the pixel combination of colors (KCMY or KCMYcm) to the combination of colors that does not include any drops from the plane/pen with the nozzle out that matches closest in L^* to the original color.

Advantages: What are the advantages of the invention over what has been done before?

These methods allow the printer to continue printing in a one-pass print mode even though there are nozzle outs that would otherwise negatively affect print quality. Throughput is maintained at a high pace, while print quality is remains high.

Description: Describe the construction and operation of the invention.

The algorithms would be implemented in the software of the pipeline of the printer. The drop detect on the printer would know which nozzles were out and implement the appropriate algorithm if one-pass printing with error-hiding was requested by the user.

Invention History

Section Complete

Published: Was a description of the invention published, or are you planning to publish? If so, when and in what publications?

Published: No

Announced: Was a product including the invention announced, offered for sale, sold, or is such activity proposed? If so, when and where?

Announced: No

Disclosed: Was the invention disclosed to anyone outside of HP, or will such disclosure occur? If so, when and to whom?

Disclosed: No

Urgency: Will the invention be published, announced, or disclosed in the next 3 months?

No

Described: Was the invention described in a lab book or other record?

Described: Yes

Described Details: Described in Jeff Barr's Lab book

Built: Was the invention built, modeled, or tested? If so, when?

Built: Yes

Date Built: [REDACTED]

Government Contract: Was the invention made under a government contract? If so, the agency and contract number:

Government Contract: No

Inventor Information

Section Complete

Inventor(s): Pursuant to my (our) employment agreement, I (we) submit this disclosure:

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Inventor Home Addresses: Enter the home address of each Inventor. This information is legally required to process your Invention Disclosure.

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Inventors	Country of Citizenship
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Korngiebel, Jennifer M (Jenn)	United States [US]
Heiles, Tod	United States [US]
Webb, Steven L	United States [US]
Rutland, Jeffrey D	United States [US]

Inventor Mail Stops: Enter the HP Mail Stop for each Inventor.

Inventors	HP Mail Stop
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Korngiebel, Jennifer M (Jenn)	61U250
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Webb, Steven L	61U250
Rutland, Jeffrey D	61U250

Non-HP Inventors: Please list the names, home addresses, telephone numbers, email addresses, and countries of citizenship of inventors who are not affiliated with HP.**Witness Information**

Section Complete

Witnesses: This invention has been explained to and understood by the following witnesses. You must name at least two witnesses.

Bauer, Stephen W [00255218] San Diego, CA, USA	Telnet: 655-8430 Location Code: 111N-5199	steve_w_bauer@am.exch.hp.com Added by Barr, Jeffrey H on [REDACTED]
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Witness Dates: At what date was this invention first explained to and understood by each witness?

Witnesses	Date Understood
Bauer, Stephen W	[REDACTED]
Rutland, Jeffrey D	[REDACTED]

Additional Information

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Electronic Documents: Do you have electronic document files to upload? Please convert your documents into MS Word, PowerPoint, Adobe Acrobat, or plain text format.

File Name Click to View	Size Bytes	Uploaded Date	Uploaded By User
one_pass1.pdf	420973	[REDACTED]	Barr, Jeffrey H
one_pass2.pdf	358258	[REDACTED]	Barr, Jeffrey H

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Paper Documents: Do you have paper documents to include with your Invention Disclosure that you would like to send by FAX?

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Categories: Select WKRP categories where this invention disclosure should be indexed.

General: Printing Methods

Keyword(s): Select keywords to index this invention disclosure.

Error Hiding

Innovation Workshop: Was this Invention Disclosure prepared as a result of an Innovation Workshop? If you are not sure, select No.

No

Related to a Previous Submission: Does this disclosure relate to a previously submitted disclosure? If so, please provide the PD number of the related disclosure and explain.

Related Disclosure: No

Administrative Record

3 Required Fields Remaining

Patent Clerk: Select the name of the Patent Clerk(s) working on this Invention Disclosure:

Isagawa, Michiko [00528430] San Diego, CA, USA	Telnet: 655-3341 Location Code: 111N-5129	michiko_isagawa2@am.exch.hp.com Added by Isagawa, Michiko on [REDACTED]
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PD Number and Legal Received Date: Record the PD number assigned by Merlin and modify the date this disclosure was received, if necessary.

Patent Coordinator(s): Select Patent Coordinator(s) who will work on this Invention Disclosure:

Childers, Winthrop D [00254722] San Diego, CA, USA	Telnet: 655-4911 Location Code: 111N-5129	winthrop_childers@am.exch.hp.com Added by Lygas, Ann on [REDACTED]
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Managing Attorney(s): Select Managing Attorney(s) assigned to this Invention Disclosure:

Legal Entity and Site: Select a Legal Entity and Site where this Invention Disclosure will be handled and reviewed:

Legal Entity: IJS

Legal Site: San Diego

Review Record

2 Required Fields Remaining

Assigned Reviewer: Select the name of the Reviewer(s) who will review this disclosure before the Site Review Committee meeting:

Functional Segment: Select the functional segments in which this disclosure will be reviewed:

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From Page No.

Leave: When printing in a one-pass print mode the ability to hide a nozzle out with a different nozzle is hampered because all pixels in a row are always printed with a common nozzle.

If this common nozzle is out there would be no way to hide the nozzle out with current error hiding techniques that depend on multiple passes.

① DEAS

Boost the amount of ink used in adjacent nozzles to the nozzle that is out. Boost the ink usage in adjacent nozzles by the amount of ink ~~in the~~ that should be printed by the nozzle that is out. Vary the boost between the nozzle above and the nozzle below (i.e. if nozzle 267 is out, boost nozzles 266 and 268, alternately). Try to boost empty pixels before adding to pixels with ink.

For example:

If pixel pattern of drops for 3 nozzles is ~~when level =~~

266	1 2 0 0 1 1 2 2 1 2
267	1 1 1 0 2 1 0 0 1 1
268	2 0 1 0 1 2 1 0 2 2

Boost nozzles so pattern looks like

266	2 2 1 1 2 2 2 2 2 2
267	1 1 1 2 2 1 0 0 1 1
268	2 1 1 1 2 2 1 0 2 2

note if max level reached
do not boost any higher

Witnessed & Understood by me,

Date

Invented by

A. A. M.

Date

To Page No.

From Page No. _____

Benefits

This allows the printer to continue printing on single pass print mode even though there are nozzle clogs. Throughput is maintained while quality remains high.

Idea: some nozzle clogs

For the cyan nozzle out match the pixel combination of colors (KCMY) to the combination of colors. It is important to include the cyan in the pixel pattern with the nozzle out that is the closest match in L^* .

For example if a pixels have a

1 drop K
2 drops C
0 drops M
2 drops Y

On plain paper in a one pass print mode its L^* average is ≈ 50.68

If the cyan nozzle goes out the combination of drop in/out cyan that is closest in L^* would be

1 drop K } 0 drops C } on plain paper in a
0 drops C } 0 drops M } one pass print mode its
1 drop Y } L^* average is ≈ 48.59

The L^* difference is 2.09. However the print would no longer need to use the cyan nozzle.

10014029 disclosure entitled "One Pass Printing Error Hiding Methods".

Issue: When printing in a one-pass printmode the ability to hide a nozzle out with a different nozzle is hampered because all pixels in a row are always printed with a common nozzle.

If this common nozzle is out there would be no way to hide the nozzle out with current error hiding techniques that depend on multiple passes.

Idea 1: Boost the amount of ink used in adjacent nozzles to the nozzle that is out. Boost the ink usage in adjacent nozzles by the amount of ink that should be printed by the nozzle that is out. Vary the boost between the nozzle above and the nozzle below (i.e. if nozzle 267 is out, boost nozzles 266 and 268, alternately). Try to boost empty pixels before adding to pixels with ink. For example: If pixel pattern of drops for 3 nozzles is with ink level=

266	12 0 0 1 1 2 2 1 2
267	1 1 1 2 2 1 0 0 1 1
268	2 0 1 0 1 2 1 0 2 2

Boost nozzles so pattern looks like:

266	2 2 1 1 2 2 2 2 2 2
267	1 1 1 2 2 1 0 0 1 1
268	2 1 1 1 2 2 1 0 2 2*

*Note: If max level reached do not boost any higher

Benefits: This allows the printer to continue printing in single-pass print mode even though there are nozzle outs. Throughput is maintained while quality remains high.

Idea 2: Same benefits. For the low with a nozzle out match the pixel combination of colors (KCMY or KCMYom - Spelling?) to the combination of colors that does not include any ? From the plane/pen with the nozzle out that is the closest match in L*

For example, if a pixel is made of 1 drop K, 2 drops C, 0 drops M, 2 drops Y, on plain paper in a one pass print mode it's L* average is ~50.68. If the cyan nozzle goes out the combination of drops without cyan that is closest in L* would be 1 drop K, 0 drops C, 0 drops M, 1 drop Y on plain paper in a one pass print mode its L* average is ~ 48.59. The L* difference is 209. However, the pixel would no longer need to use the cyan nozzle.

PenHigh_PlainNormal_ImageExperiment

Pen: Cyan, Magenta, then Yellow experiment with all 3
Media: Paper
Quality: Normal Mode
Slew: 1 pass, 30 ips, bidi
Data in: 600 dpi 2 bit/4 levels
Data out: 1200 dpi

Tod Heiles

Pen high mask with different experimental replacement conditions for level 1 at nozzles 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170 substitute individually for each pen color to assess the optimum adjacent replacement for each color. Black is done in a separate experiment.

Pen high masks for 1 pass printing to specify nozzle replacement. For missing nozzles on the cyan, magenta, and cyan pens, boost the adjacent rows from 1 drop/pixel to around 1.5 drops. Experimentation required to determine level 1 optimum adjacent ink boost for each color. If 2 drops_level1600 are used for level2, the pen is already firing at full frequency so adjacent rows can't be modified. If sufficient headroom exists to reduce level 2 to 1.5-1.8 drops, there might be benefit to boosting adjacent nozzles.

To identify missing nozzles, print the aligned 512 height staircase pattern.

If cyan nozzle 110 is missing:

```
Modify C level 1 with
[ ( 0, 1 ) [ ( 0, 1 ) ( 0, 1 ) [ ( 0, 1 ) ( 0, 1 ) [ ( 0, 1 ) ( 0, 1 ) | // -1 Adjacent boost to 1.5 drops
[ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] | // remove missing (or leave at 1?)
[ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] | // +1 Adjacent boost to 1.5 drops
```

If two adjacent cyan nozzles 110 and 111 is missing:

```
Modify C level 1 with
[ ( 0, 1 ) ( 0, 1 ) [ ( 0, 1 ) ( 0, 1 ) [ ( 0, 1 ) ( 0, 1 ) [ ( 0, 1 ) ( 0, 1 ) | // -1 Adjacent boost to 2 drops
[ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] | // remove missing (or leave at 1?)
[ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] | // remove missing (or leave at 1?)
[ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] | // +1 Adjacent boost to 2 drops
```

If two adjacent cyan nozzles 110 and 112 is missing with 1 between:

```
Modify C level 1 with 1 in between
[ ( 0, 1 ) ( 0, 1 ) [ ( 0, 1 ) ( 0, 1 ) [ ( 0, 1 ) ( 0, 1 ) [ ( 0, 1 ) ( 0, 1 ) | // -1 Adjacent boost to 1.5 drops
[ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] | // remove missing (or leave at 1?)
[ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] | // 1 between boost to 2 drops
[ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] | // remove missing (or leave at 1?)
[ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] [ ( 0, 1 ) ( 0, 1 ) ] | // +1 Adjacent boost to 1.5 drops
```

PenHigh_PlainNormal_ImageExperiment

```

// If two adjacent cyan nozzles 110 and 111 are missing with 2 or more between them can be treated as separate groups since
// the adjacent replacement only extends out 1 nozzle to replace the missing ink.

For each missing black nozzle
// boost level 3 underprinting on the cyan and magenta to full 2 drops per cell_600 fill
// eliminate level 3 underprinting on the cyan and magenta for adjacent nozzles 2 and 3 away
// Cut and paste from the following example situations, removing the comments

```

If black nozzle 110 is missing:
 Modify C and M level 3 with

```

[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // -3 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // -2 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // -1 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // MISSING K
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +1 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +2 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +3 Adjacent eliminate underprinting for ink mobility

```

If two adjacent missing nozzles are missing, replace as follows ie if nozzle 110 & 111 are missing:
 If 3 or more are adjacent, insert the same behavior.

```

Modify C and M level 3 with
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // -3 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // -2 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // -1 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // at MISSING K Boost underprinting
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // at MISSING K Boost underprinting
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +1 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +2 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +3 Adjacent eliminate underprinting for ink mobility

```

If 2 adjacent missing nozzles are missing with 1 between, replace as follows ie if nozzle 110 & 112 are missing:

```

Modify C and M level 3 with
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // -3 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // -2 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +1 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // at MISSING K Boost underprinting
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // 1 between MISSING K Boost underprinting
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // at MISSING K Boost underprinting
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +1 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +2 Adjacent eliminate underprinting for ink mobility
[0,0,0] [0,0,0] [0,0,0] [0,0,0] | // +3 Adjacent eliminate underprinting for ink mobility

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ImageE9

PlainNormal

PenHigh

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